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HOME DYEING WITH NATURAL DYES

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HOME DYEING WITH NATURAL DYES

Table of Contents

KIND OF NATURAL DYES - - - - -	2
ACTION OF DYES ON TEXTILE FIBERS - - - - -	2
FASTNESS OF DYES - - - - -	3
EQUIPMENT AND SUPPLIES - - - - -	4
PREPARING THE YARN OR FABRIC FOR DYEING - - - - -	5
DYE RECIPES - - - - -	7
TABLE OF COLORS - - - - -	25

Natural dyes are particularly adapted to handicraft work. Although in many cases they are not so good as synthetic dyes, that is, dyes manufactured by chemical processes, they have an appropriateness and an esthetic quality which give them definite commercial value in the handicraft industries. Natural dyes are often preferred for coloring the yarns and cloth used in making hooked rugs, hand-woven scarfs, coverlets, pillow covers, and many other useful articles. This type of work serves not only as an expression of artistic ability, but for many people it recently has become a very important source of family income. In connection with the subsistence homesteads project and similar Federal and State relief activities now under way, handicraft industries are being initiated and encouraged.

If this revival of interest in hand-made textiles is to survive and be commercially profitable, the colors used must be pleasing and fast to light and to washing. Fading or bleeding of the dyes soon leads to dissatisfaction and a decrease in sales. Although many natural dyes do produce fast colors, some change and fade quickly and soon become dull and uninteresting. It is therefore essential that the handicraft worker know which dye materials to use and how to obtain fast and beautiful colors. Unfortunately few books are available on this subject, and even these supply very meager information concerning the use of natural dyes and tell nothing about their relative fastness.

As a basis for this publication,^{1/} wool and cotton fabrics were dyed with all the commonly used natural dyestuffs and samples of each were tested for their fastness to light and to washing. By no means did all the dye materials produce fast colors; many had to be discarded entirely and some were found to be fast only when applied by certain methods of dyeing. This publication includes only those recipes which produce colors on wool or cotton that are fast to light and to washing.

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KINDS OF NATURAL DYES

Natural dyes may be of animal, mineral, or vegetable origin. For instance, cochineal, which gives lovely red colors, is prepared from a dried insect, and the colors chrome yellow, manganese brown, and iron buff are developed by minerals. Vegetable materials such as leaves, flowers, nut hulls, and the bark of trees and shrubs have long been a source of dyestuffs for coloring fabrics. They produce dyes of rich, soft shades and by combining various dyes or by dyeing one color over another a wide range of colors is possible. Most natural dyes are of vegetable origin and the terms "natural" and "vegetable" are generally used interchangeably.

Natural dyestuffs may be grouped into the following classes: mordant, direct, vat, acid, basic, and mineral dyes.

Practically all the vegetable dyes are mordant dyes, that is, they require a chemical known as a mordant to help fix the color on the fabric. The first step in the dyeing process, then, is to soak the thoroughly cleaned yarn or fabric in a solution of the mordant which is usually a compound of chromium, aluminum, iron, or tin. When it goes into the dyebath, the dyestuff combines with this mordanted material to form a fast color. The same dye often gives very different colors with different mordants. For instance, logwood used with an iron mordant produces a good black, with chrome a blue, and with alum a medium purple.

Some of the natural dyes are direct dyes, that is, they are applied directly to the fiber without a mordant. These, as a rule, do not produce fast colors. Annatto, the dye used for coloring butter, and also some of the lichen dyes belong to this class.

Indigo is a vat dye. These dyes get their name from the fact that the dye, a reducing agent to change the dye, and an alkali to dissolve it so that the fiber can take it up, are all combined in a vat. The fabric is dipped in this dyebath, then exposed to the air a few minutes, and the process repeated until the desired color is developed. The air acts on the dye forming a color on the cloth which is very fast to light and to washing.

A few of the natural dyes are acid dyes. These require the addition of an acid in the dyebath. Some basic dyes also are applied in an acid dyebath; others in a neutral one. They dye wool directly and cotton on a tannin mordant.

The mineral dyes, such as chrome yellow and Prussian blue, color fabrics by forming a finely divided colored deposit throughout the fiber. They do not react with fibers.

ACTION OF DYES ON TEXTILE FIBERS

Of all the textile fibers, wool can be dyed most easily and satisfactorily. It will combine with practically all kinds of dyes, probably forming a chemical union with the dyestuff.

Silk, which is chemically similar to wool, acts much the same way and can usually be dyed easily. However, old, weighted silk cannot always be redyed satisfactorily. It may be so weakened that it falls apart in the dyebath or it may dye in streaks.

Cotton, linen, and other vegetable fibers will not combine with dyes as do the animal fibers. Fast colors are produced on them only by complicated dyeing processes or by the use of mordants.

Some rayons can be dyed the same as cotton except that the dyebath must be kept below the boiling point. Others need special treatment.

FASTNESS OF DYES

The fastness or permanence of a dye is very important. No color is absolutely fast to all agencies. It may be fast to one; for example, to light, or to perspiration, or to washing, but not fast to all three or even to two. Furthermore, a dye may be fast on one fiber and not on another; or it may be fast when dyed with one mordant and not fast when dyed with another. The need for a particular kind of fastness depends on the nature of the color change and the use to be made of the dyed fabric. For example, a wool fabric dyed a brown shade with tree bark may darken somewhat on exposure to light, but if used in a hooked rug would doubtless be entirely satisfactory. On the other hand, the color change in that same material when used for window draperies might soon become objectionable.

To make sure that the recipes given on pages 7 to 25 produce colors permanent enough to be useful for most purposes, samples of fabrics dyed according to these directions were tested by the following methods and the results included in the dye recipes.

Fastness to Light and Washing

For the light test, samples of the dyed fabrics were cut and exposed for 48 hours to the rays of a carbon-arc lamp. Throughout the test period half of each sample was shielded from the light while the rays of the lamp shone directly on the other half. Then the two parts were compared and the fastness to light rated as follows:

Good: No appreciable change of color.

Fair: Appreciable but not objectionable change of color.

Poor: Objectionable change of color.

Though these light tests were run in a standard fading machine, the same method can be followed at home by exposing samples to the sunlight. Cut 2-inch square openings in each of two pieces of heavy cardboard, fasten a sample of dyed cloth to one with gummed paper and cover with the other piece of cardboard so that the openings correspond. It is important that the light come through the sample. Then place this sample in its frame out of doors in the direct sunlight and tilted towards the sun. After a few days remove the sample and compare the section exposed to the sun with the covered portion.

For the washing test, samples were prepared by sewing a piece of dyed fabric measuring 2 by 4 inches to a similar piece of undyed fabric. It was then placed in a half pint fruit jar partly filled with neutral soap solution (0.5 per cent for wool and 0.1 per cent for cotton) at 120° F. and agitated in a shaking machine for 30 minutes. The sample was removed, squeezed through a wringer, and rinsed by agitating in water for 10 minutes. Rinsing was repeated five times and the temperature of each rinse gradually dropped from 120° F. to 95° F. The samples were dried quickly, then compared with the original unwashed fabric, and rated good, fair, and poor, as for the light test. A similar test can easily be made at home.

EQUIPMENT AND SUPPLIES

Elaborate equipment for dyeing is not necessary. However, a few things are essential for good results. Since the quantity of dye materials to use depends on the weight of the material being dyed, a balance or a pair of scales to weigh them accurately is necessary. The recipes given on pages 7 to 25 are based on 1 pound of yarn or cloth.

The kettle for the dyebath should be enamelware or copper. The old dye recipes usually called for a copper kettle and many craft dyers still prefer one. Avoid using an iron kettle except for very dark or dull colors, because iron reacts with many dye materials to darken or "sadden" them. Also do not use a tin kettle for tin makes colors harsh. The dye kettle must be large enough so that the cloth can be completely immersed and moved about freely.

Have plenty of water to cover the fabric completely, and use soft water, for it allows better penetration of the dye. If only hard water is available, a water softener will remove some of the hardness, but this is not always satisfactory as the chemical used may affect the color of the dye.

Plenty of water for rinsing, a thermometer to test the temperature of the dyebath and rinse water, and extra pails or kettles in which to rinse, are absolutely necessary. Of course, a good stove for heating the water is also essential. If possible, a stove lower than the ordinary should be used, to make easier the task of lifting the water and stirring the goods in the dyebath.

While the material is being dyed, it must be stirred and turned and kept in constant motion. Sticks of smooth wood or glass towel rods are very satisfactory for this purpose. If much dyeing is done, have a set of sticks or stirring rods for each color. Good rubber gloves to protect the hands from the dyes are also useful.

Pieces of cheesecloth washed free from lint are very convenient for straining the dye liquor. Also some dye materials, such as logwood chips and nut hulls, must be tied in a cloth bag during the dyeing process. Otherwise, the dye particles might stick to the fabric and cause spots. Then, too, if the color developing on the yarn or fabric is becoming too intense, the bag can be removed without stopping the boiling.

PREPARING THE YARN OR FABRIC FOR DYEING

Weighing

To prepare the yarn or fabric for dyeing, first weigh it while still dry. It is necessary to know this weight to determine not only the amount of dye materials needed but also for the amount of soap to be used in washing, and the chemicals for mordanting. After weighing, washing, and mordanting, the material is ready for dyeing.

Washing

In order that the dye solution will penetrate perfectly and evenly, the yarn or fabric to be dyed should be washed well in soap and water. Any starch and sizing materials present in cloth will prevent it from wetting-out readily and must therefore be removed. Spots and stains may also cause uneven dyeing, and should be treated before washing the fabric. (See U. S. Dept. Agr. Farmers' Bull. 1474, "Stain removal from fabrics; home methods.")

Washing Wool

For each pound of wool yarn or fabric, make a suds of 0.8 ounce of good neutral soap in 5 gallons of water at 95° F. Wash the material thoroughly for 30 minutes, and squeeze out the suds. Then wash in a second suds at the same temperature for 30 minutes, this time using 0.3 ounce of soap for a pound of cloth. After squeezing out the suds, rinse three or four times for 10 minutes each in water at 95° F.

To prevent felting and shrinking, handle wool quickly and pass it directly from the suds to the rinses without delay. It is very important also that the temperature of the suds and rinses be the same and never higher than 100° F. Always squeeze out the rinse water evenly and never wring or twist wool.

Often wool not yet spun into yarn is dyed. Of course the raw wool must first be thoroughly scoured and cleaned to remove the natural wax and grease. (See Bureau of Home Economics mimeographed circular "How to prepare raw wool at home for bedding.") This is essential for good dyeing because these impurities tend to make the fiber water-repellent and the dye cannot penetrate. After scouring and dyeing, the wool is then carded and spun into yarn. By mixing different colors in carding, lovely color combinations can be obtained. If a solid color is desired, dyeing the wool after it has been spun into yarn may be more convenient.

Washing Cotton

For each pound of cotton material, make a suds of 0.8 ounce of good neutral soap in 5 gallons of water at 140° F. Wash thoroughly for 30 minutes, wring out the suds, and wash in a second suds of 0.4 ounce of soap per pound of material with the water at 140° F. Rinse once at this same temperature. For the second rinse have the water at 158° F. and let the cotton soak in the water a half hour or more. Then follow with two or three cooler rinses.

Mordanting

Most of the vegetable dyes require a chemical known as a mordant to hold or fix the color into the fiber. If wool, for example, is boiled in a solution of logwood, it is in a sense dyed, but the color does not hold and washes out almost entirely. It needs a mordant such as alum, chrome, or a tin salt, to hold the color. The mordant unites with both the fiber and the dye; thus it is a link combining the two.

Mordants are of three classes: (1) the metallic mordants, such as chrome, alum, and tin salts; (2) tannin mordants, such as cutch, sumac, and tannic acid; and (3) oil mordants, such as Turkey-red oil and fatty acids.

Wool and silk have the property of holding metallic salts in their fibers. When wool, for instance, is boiled in a solution of potassium dichromate (chrome mordant) a certain amount of chromium oxide is held in the fiber, and the dye-stuff then combines with this prepared wool to form a permanent color. Cotton and the other vegetable fibers do not absorb the metallic salts (mordants) so readily as wool. However, they possess the property of combining with tannic acid and this furnishes a method of preparing these fibers for dyeing. Tannic acid can be used either as a mordant itself for holding colors or for fixing metallic mordants in the fibers.

Metallic salts are sometimes used in after-treatment of certain dyed colors. The yarn or fabric is mordanted as usual, dyed, and then treated with potassium dichromate, ferrous sulfate, or copper sulfate. The action of these salts is probably not the same as that of a mordant, although in many cases the resulting color has increased fastness.

Methods for Mordanting Wool

Alum.- For each pound of wool, allow:

4 ounces potash alum
1 ounce cream of tartar

Dissolve the alum and cream of tartar in 4 to 4-1/2 gallons of cold water and immerse the wool yarn or cloth, thoroughly wet and squeezed out of water. Heat gradually, stirring and turning the yarn or cloth all the time, and boil for 1 hour. Allow the material to cool overnight in the mordant and in the morning squeeze it from the mordant bath, roll in a dry towel, and put in a cool place. Rinse well just before putting it into the dyebath.

Chrome.- For each pound of wool, use:

1/2 ounce potassium dichromate

Dissolve the potassium dichromate in 4 to 4-1/2 gallons of cold water and follow the directions for mordanting wool with alum.

Tin.- For each pound of wool, allow:

2/3 ounce stannous chloride
1/3 ounce oxalic acid

Dissolve the stannous chloride and oxalic acid in 4 to 4-1/2 gallons of cold water and immerse the wool yarn or cloth which has been thoroughly wet and

squeezed out of water. Heat very gradually, stir constantly, and boil for 1 hour. Take care that the volume of mordant bath remains the same, if necessary add boiling water from time to time. Rinse well and dye immediately.

Methods for Mordanting Cotton

Alum.- For each pound of cotton, allow:

4 ounces potash alum

1 ounce sodium carbonate (washing soda)

Dissolve the alum and washing soda in 4 to 4-1/2 gallons of cold water and immerse the cotton yarn or cloth, which has been thoroughly wet and wrung out of water. Stir well, heat gradually, and boil for 1 hour. Cool and allow to remain in the bath overnight. In the morning squeeze from the mordant bath, roll in a dry towel, and put in a cool place. Rinse the material well just before putting it in the dyebath.

Alum-tannin-alum.- For each pound of cotton, allow:

8 ounces potash alum

2 ounces sodium carbonate (washing soda)

12 ounces powdered oak galls or 1 ounce tannic acid

Dissolve half of the alum and half of the washing soda in 4 to 4-1/2 gallons of cold water and immerse the cotton yarn or cloth, which has been thoroughly wet and wrung out of water. Stir well, heat gradually to boiling, and boil for 1 hour. Allow the material to cool overnight in the mordant and in the morning squeeze it out, rinse, and put into a bath of oak galls at 140° to 158° F. Work it in this bath for 1 hour and let stand overnight. Then rinse slightly. With the rest of the alum and washing soda prepare another mordant bath and mordant the material again in alum. Let stand overnight in the mordant bath. In the morning squeeze out the cotton and rinse just before dyeing.

Chrome.- For each pound of cotton, use:

1/2 ounce potassium dichromate

Dissolve the potassium dichromate in 4 to 4-1/2 gallons of cold water and follow directions for mordanting cotton with alum.

DYE RECIPES

The quantities of dyestuffs to use depend upon the weight of the dry fabric being dyed. The dye materials must be weighed and prepared as the dye recipe directs and strained into the water for the dyebath. Use plenty of water, at least 4 to 4-1/2 gallons for each pound of yarn or cloth; otherwise, the material will be crowded, causing streaks and spotted places. Soft water always gives better results.

Rinse the mordanted yarn or fabric well, squeeze lightly, then quickly immerse it in the dyebath. Stir and turn it so that all parts are heated evenly. Be sure to keep the goods well opened out and in constant motion. This is essential for good dyeing. Bring the temperature of the dyebath up gradually and simmer or boil as the directions state. Different materials require different lengths of time in the dyebath to produce the same shade. Thick or hard-woven materials require longer boiling than softer ones, for dye penetrates more slowly on closely woven goods.

Rinse the dyed yarn or fabric in water of the same temperature as the dye-bath and finally in cooler water. Keep rinsing, using plenty of water until the rinse water is clear. Crocking or rubbing of the dye from the material is usually caused by insufficient rinsing. Never change wool materials directly from a hot bath to a cold rinse, as sudden changes in temperature cause wool to shrink and become harsh.

Squeeze or press out as much water from the dyed material as possible. Do not twist or wring it, for this causes streaks and wrinkles which are difficult to remove. Roll the material for a few minutes in a clean cloth or towel to absorb any excess moisture, then shake it well and hang in the shade. When dry enough to iron, cover the fabric with a cloth and press on the wrong side.

Do not expect exact duplication of the color each time a recipe is used even though you follow the instructions carefully. Vegetable dye materials vary so much in composition and contain, besides coloring matter, so many other substances which are extracted into the dye liquor that fabrics seldom come out twice alike in shade and intensity of color. Therefore dye the amount of yarn or cloth of each color needed for a piece of handicraft work at one time, instead of trying to match the color by a second dyeing.

The following recipes for using natural dyes are arranged according to the source of the dye material. Since the dyes of vegetable origin are more numerous their recipes are given first. They are grouped under the headings: barks, berries, flowers, leaves, nut hulls, roots, and woods.

Barks

The barks of many of our common trees supply coloring materials for yarns and cloth. Of those discussed here, black or quercitron oak has the greatest coloring power. The dyestuff, quercitron, prepared from the inner bark is used commercially for textile printing and leather dyeing. Barks produce colors on wool varying from light tan to brown, often with a greenish tone. Barks do not dye cotton satisfactorily.

Most barks are best collected in the fall or winter, though resinous barks may be gathered in the spring. Generally the inner bark is used and it may be either fresh or dried, but usually fresh barks give a stronger dye. Barks must be carefully dried and stored where they will not become damp and mouldy.

The coloring principles of these dyes are probably closely combined with tannin. Often fabrics dyed with bark are not fast to light but soon darken and become brown. To prevent this change the yarn or fabric after it is dyed can be treated with certain salts such as potassium dichromate, ferrous sulfate, and copper sulfate. These tend to fix or remove the excess tannin. Dye methods 3, 4, and 5 given below use this process.

Methods of Dyeing with Bark

Dye method 1.- For each pound of unmordanted wool yarn or cloth, use:

1 peck finely chopped bark

Soak the bark in water overnight. In the morning bring slowly to the boil and boil for 2 hours, strain twice through cheesecloth, and add enough water for the dyebath. Immerse the unmordanted material, thoroughly wet and squeezed out of water, and boil for 30 minutes. Rinse and dry.

Dye method 2.- For each pound of wool yarn or cloth mordanted either with alum or with chrome, or with tin, use:

1 peck finely chopped bark

Mordant the wool according to directions on page 6. Soak the bark in water overnight. In the morning bring slowly to the boil and boil for 2 hours, strain twice through cheesecloth, and add enough water for the dyebath. Immerse the mordanted material, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Rinse and dry.

Dye method 3.- For each pound of wool yarn or cloth mordanted with alum, allow:

1 peck finely chopped bark

1/6 ounce potassium dichromate

1/6 ounce acetic acid, or 6 to 7 tablespoons vinegar

Mordant the wool with alum according to directions on page 6. Soak the bark in water overnight. In the morning bring slowly to the boil and boil for 2 hours, strain twice through cheesecloth, and add enough water for the dyebath. Immerse the alum mordanted material, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Without rinsing, put into a boiling bath of the potassium dichromate and acetic acid, stir carefully, and boil for 15 minutes. Rinse and dry.

Dye method 4.- For each pound of wool yarn or cloth mordanted with alum or with chrome, use:

1 peck finely chopped bark

1/6 ounce copper sulfate

1/6 ounce acetic acid, or 6 to 7 tablespoons vinegar

Mordant the wool according to directions on page 6. Soak the bark in water overnight. In the morning heat gradually and boil for 2 hours, strain twice through cheesecloth, and add enough water for the dyebath. Immerse the mordanted material, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Without rinsing, put into a boiling bath of the copper sulfate and acetic acid, stir carefully, and boil for 15 minutes. Rinse and dry.

Dye method 5.- For each pound of wool yarn or cloth mordanted with alum, allow:

1 peck finely chopped bark

1/6 ounce ferrous sulfate (copperas)

Mordant the wool with alum according to directions on page 6. Soak the bark in water overnight. In the morning bring slowly to the boil and boil for 2 hours, strain twice through cheesecloth, and add enough water for the dyebath. Immerse the alum-mordanted material, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Without rinsing, put into a bath of the ferrous sulfate at 140° F., stir and turn for 15 minutes. Rinse and dry.

Apple Bark (*Malus sylvestris*)

On wool, apple bark gives the following colors, depending on the mordant and the dye method used. All of them show fair fastness to light and good fastness to washing.

Yellow tan.- Alum mordant, page 6; Dye method 2, page 9.

Dark yellow tan.- Alum mordant, page 6; Dye method 5, page 9.

Brass.- Chrome mordant, page 6; Dye method 2, page 9.

Birch Bark (*Betula* sp.)

The species of birch bark used in testing this recipe was probably yellow birch. By one method of dyeing it gave on wool a yellow tan which has fair fastness to light and good fastness to washing; by another it gave a yellow brown which has good color fastness. Yellow birch trees are found principally in northeastern United States.

Yellow tan.- Alum mordant, page 6; Dye method 4, page 9.

Yellow brown.- Alum mordant, page 6; Dye method 3, page 9.

Sweet Gum Bark (*Liquidambar styraciflua*)

The bark of the sweet gum tree, commonly found along the eastern coast of the United States, Illinois, Missouri, and Mexico, produces a light brown on wool. The color fastness is good.

Light brown.- Alum mordant, page 6; Dye method 3 or 4, page 9.

Hickory Bark (*Hicoria* sp.)

The hickory bark used in this test was probably the white hickory or mockernut (*Hicoria alba*) which grows throughout the eastern half of the United States. On wool it gave a dark yellow brown which has good color fastness.

Dark yellow brown.- Alum mordant, page 6; Dye method 3, page 9.

Norway Maple Bark (*Acer platanoides*)

By one method of dyeing, Norway maple bark produces a rose tan on wool; by another method, a light brown. Both have fair fastness to light and good fastness to washing. The Norway maple is a European species widely cultivated for ornamental purposes.

Rose tan.- Alum mordant, page 6; Dye method 4, page 9, or
Chrome mordant, page 6; Dye method 2, page 9.

Light brown.- Alum mordant, page 6; Dye method 3, page 9.

Maple Bark (*Acer* sp.)

On wool, maple bark (the species used in these tests was probably silver maple, *Acer saccharinum*) gave a greenish tan which has fair color fastness. A darker tone fast to bath light and washing was obtained by another dye method. With other mordants this bark also gave a drab and a khaki, the first of which has fair fastness to light and good fastness to washing, and the second, good color fastness. The silver maple grows throughout eastern North America.

Greenish tan.- No mordant; Dye method 1, page 3, or
Alum mordant, page 6; Dye method 3, page 9.

Drab.- Alum mordant, page 6; Dye method 5, page 9.

Khaki.- Chrome mordant, page 6; Dye method 4, page 9.

Black or Quercitron Oak Bark (*Quercus velutina*)

Quercitron is the dyestuff prepared from the inner bark of black oak or quercitron oak. These trees are found in the eastern half of the United States, especially in Pennsylvania, Georgia, and the Carolinas. The bark itself can be used as a source of the dye or a pure dye extract of quercitron called flavine can be purchased. This of course has much greater coloring power than the bark. The following directions employ quercitron extract. However, if the bark is used instead of the extract, follow Dye method 2 (chrome mordant), page 9, or Method 3, page 9.

The dyeing properties of quercitron are due to two coloring principles, quercetin and quercitrin. Considerable tannin material in the form of quercitannic acid is also present. Since tannin dulls the brilliancy of colors, prolonged boiling in a quercitron dyebath must be avoided.

On wool, quercitron produces a gold color with good fastness to light and to washing. By another method of dyeing, a yellow tan develops which has fair fastness to light and good fastness to washing. On cotton, quercitron gives a gold color, and its fastness is good.

Gold

Method 1.- For each pound of wool mordanted with chrome, allow:
1/2 ounce quercitron extract

Mordant the wool with chrome according to directions on page 6. Dissolve the quercitron extract in enough water for the dyebath, immerse the yarn or cloth thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Rinse and dry.

Method 2.- For each pound of cotton mordanted with alum-tannin-alum, allow:
1/2 ounce quercitron extract
1/6 ounce potassium dichromate
1/6 ounce acetic acid, or 6 to 7 tablespoons vinegar

Mordant the cotton in alum-tannin-alum according to directions on page 7. Dissolve the quercitron in enough water for the dyebath, immerse the goods, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Without rinsing, put the material into a boiling bath of the potassium dichromate and acetic acid. Stir carefully, and boil for 15 minutes. Rinse and dry.

Yellow tan.- For each pound of wool mordanted in alum, allow:

1/2 ounce quercitron extract

1/6 ounce potassium dichromate

1/6 ounce acetic acid, or 6 to 7 tablespoons vinegar

Mordant the wool in alum according to directions on page 6. Dissolve the quercitron in enough water for the dyebath, immerse the goods, thoroughly wet and wrung out of water, and boil for 30 minutes. Without rinsing, put the material into a boiling bath of the potassium dichromate and acetic acid. Stir carefully, and boil for 15 minutes. Rinse and dry.

Chestnut Oak Bark (*Quercus montana*)

According to the mordant used, chestnut oak bark produces on wool a yellow tan which has fair fastness to light and good fastness to washing, and a brown which has good color fastness. This tree is found in the eastern part of the United States from Maine to Alabama.

Yellow tan.- Chrome mordant, page 6; Dye method 2, page 9.

Brown.- Alum mordant, page 6; Dye method 3, page 9.

Northern Red Oak Bark (*Quercus borealis maxima*)

When different mordants and methods of dyeing are employed, this bark produces various colors on wool. It gives a rose tan which has fair color fastness; also a yellow tan, a greenish tan, and a light brown which have good color fastness. Northern red oak trees are found throughout the eastern half of the United States.

Rose tan.- No mordant; Dye method 1, page 9.

Yellow tan.- Chrome mordant, page 6; Dye method 2, page 9.

Greenish tan.- Chrome mordant, page 6; Dye method 4, page 9.

Light brown.- Alum mordant, page 6; Dye method 4, page 9.

White Oak Bark (*Quercus alba*)

This tree grows in the eastern half of the United States and its bark produces on wool a yellow brown which has good color fastness.

Yellow brown.- Alum mordant, page 6; Dye method 3, page 9.

Tupelo or Black Gum Bark (*Nyssa sylvatica*)

Depending on the dye method used, tupelo bark produces a yellow tan, a dark yellow tan, and a greenish tan on wool. All three colors have fair fastness to light and good fastness to washing. This tree is a common forest tree in the eastern half of the United States.

Yellow tan.- Alum mordant, page 6; Dye method 2, page 9.

Dark yellow tan.- Alum mordant, page 6; Dye method 4, page 9.

Greenish tan.- Alum mordant, page 6; Dye method 3, page 9.

Black Walnut Bark (*Juglans nigra*)

On wool, black walnut bark gives a dark yellow tan which has fair fastness to light and good fastness to washing. With different mordants and methods of dyeing, a yellow brown, a dark yellow brown, and a dark brown also are obtained. These three all have good color fastness. The black walnut tree grows throughout the eastern half of the United States.

Dark yellow tan.- Chrome mordant, page 6; Dye method 2, page 9.

Yellow brown.- Alum mordant, page 6; Dye method 4, page 9.

Dark yellow brown.- Tin mordant, page 6; Dye method 2, page 9.

Dark brown.- Alum mordant, page 6; Dye method 3, page 9.

Black Willow Bark (*Salix nigra*)

On wool, black willow bark produces a rose tan and a light brown, according to the dye method used. Both have fair fastness to light and good fastness to washing. The black willow tree is found in eastern North America.

Rose tan.- Alum mordant, page 6; Dye method 2, page 9.

Light brown.- Alum mordant, page 6; Dye method 3, page 9.

Berries

The berries of pokeweed, cranberry, blueberry, blackberry, and juniper are sources of dye material. Pokeberries give a beautiful deep cardinal on wool, cranberries a soft pink, blueberries a light purple, and blackberries make a reddish purple, but the colors change quickly with light and washing. Juniper berries produce a fast color on wool.

Juniper Berries (*Juniperus* spp.)

Juniper, also called red cedar, grows in many sections of the United States. The bark, berries, and twigs of any species are suitable for dyeing purposes. On wool, the berries give a khaki color when applied with alum and copper sulfate. It is fast to light and to washing.

Khaki.- For each pound of wool, allow:

- 2 quarts ripe juniper berries
- 2 ounces potash alum
- 3/4 ounce ammonium chloride
- 1 ounce cream of tartar
- 1 ounce copper sulfate
- 1 ounce copper acetate.

Dissolve the alum, ammonium chloride, cream of tartar, and copper sulfate in water; put in the wool material, wet thoroughly and squeezed out of water, boil for 1 hour, and let stand in the mordanting liquor until cold. Break up the berries, tie in a cheesecloth bag and soak in clear water overnight, then boil 1 hour. Enter the mordanted yarn or cloth in this dye extract and boil for 1 to 2 hours. Remove the material, put in the copper acetate, and when dissolved return the yarn or cloth and boil for 15 to 30 minutes longer. Rinse and dry.

Flowers

Many flowers are sources of dye materials though attempts to transfer their lovely colorings to yarns and fabrics do not always meet with success. Some of the extracted dyes are very fugitive; others do not give satisfactory colors to cloth. The greenish yellow of golden rod has poor light fastness. However, both the coreopsis and the common marigold produce very fast colors on wool.

Coreopsis Flowers (Coreopsis sp.)

The coreopsis, commonly called the "yellow dye flower," is widely used in coloring yarns and fabrics for handicraft purposes. On wool, the flowers produce a terra cotta or brick color which has good color fastness. Coreopsis flowers do not dye cotton.

Terra cotta.- For each pound of wool mordanted with chrome, use:

- 1 to 1-1/2 pecks fresh coreopsis flower heads

Mordant the wool with chrome according to directions on page 6. Boil the flowers in water for 10 or 15 minutes, strain, and add enough water for the dyebath. Immerse the yarn or cloth, thoroughly rinsed and squeezed out of water, and boil for 20 minutes or until the desired color is obtained. Rinse and dry.

Marigold Flowers (Tagetes sp.)

The coloring principle in the flower of the marigold is quercetagenin which is similar to quercetin, the coloring matter of black or quercitron oak bark. On wool, marigold flowers produce a brass color that has good fastness to both light and washing. On cotton, it gives a light yellow with good fastness to light but poor to washing.

Brass.- For each pound of wool mordanted with chrome, use:

- 1 to 1-1/2 pecks fresh marigold flower heads

Mordant the wool with chrome according to directions on page 6. Boil the flowers in water for 10 or 15 minutes, strain, and add enough water for the dyebath. Immerse the yarn or cloth thoroughly rinsed and squeezed out of water, and boil for 20 minutes. Rinse and dry.

Leaves

Leaves from certain trees and shrubs yield dyes suitable for coloring yarns and fabrics. The leaves are usually collected as they are coming into full growth, though some are gathered when mature, in the early autumn. They should be used either at once or after careful drying. It takes about one-third the quantity of dried leaves as fresh ones.

The leaves of indigo, laurel, lily-of-the-valley, privet, and of the tulip tree are a good source of dye. Others, such as birch, peach, and willow produce colors that change in the light although their fastness to washing is usually good. Tea leaves with ferrous sulfate give a gray to both wool and cotton but their color fastness is poor and they are not recommended.

Indigo (*Indigofera* spp.)

Indigo, one of the oldest dyestuffs known, was probably first used in India and Egypt. It was introduced into Europe during the 16th century where it met much opposition by the cultivators of a similar dye, woad. Indigo is still extensively used and can be obtained at many dye supply houses. It produces on wool and cotton a dark blue which is very fast to light and to washing.

This dye is derived principally from the leaves of several plants of the genus *Indigofera*. Its coloring principle is indigotine but the crude product also contains several others. The best indigo comes from Bengal and Java. A synthetic indigo which is identical with the natural product can be prepared more cheaply and because of its purity usually gives somewhat clearer and brighter colors.

Indigo does not require a mordant. It belongs to the group of so-called "vat" dyes which are given this name because they are applied in a special kind of a dye bath called a vat. Since the dye itself is not soluble in water, it must first be changed by a reducing agent and then dissolved in alkali so that the wool or cotton fiber can take it up. The material is dyed by repeatedly dipping it in the dye and holding it in the air until the desired color is developed. The air acts on the dye forming a permanently fast color. In the old manner of dyeing with indigo, the blue-pot method, the bacteria which form in the vat act on the dye to reduce and change it. Although dyeing by this method is somewhat complicated, there is no difficulty in developing a good fast color on both cotton and wool if the vat has been properly prepared.

An entirely different method of dyeing with indigo is to use an indigo extract, made by dissolving indigo in sulfuric acid. To dye with this, use an alum mordant. However, this method cannot be used on cotton and even on wool the color fastness is poor, so only the blue-pot method is given here.

Dark blue. - For each pound of wool or cotton, allow:

- 1 pound powdered indigo
- 8 ounces wheat bran
- 8 ounces madder
- 3 pounds sodium carbonate (washing soda)
- 8 gallons water

Mix ingredients and let stand at 82° to 86° F. until the mixture develops a disagreeable odor, a bluish, coppery scum on top, and green streaks through it. The dye is then ready to use. This may take from 5 to 10 days. The blue pot should be stirred well each morning.

To prepare wool yarn or cloth for dyeing, soak it for 30 minutes in a solution of 1/2 ounce of washing soda to 4 gallons of water at 77° F., and rinse well. Then dip the wool in the indigo blue pot which should be kept at 95° F., stir well, and air at intervals. Continue the dipping and airing for 30 minutes, then squeeze out dye, and air for half an hour. Repeat this process several times, increasing the time of immersion of the cloth in the dye until the desired color is obtained. The material should be turned and stirred in the dye occasionally to insure an even color. When the color is dark enough, rinse in lukewarm water and dry.

To prepare cotton yarn or cloth for dyeing, boil it for 30 minutes in a solution of 1/2 ounce of sodium hydroxide to 4 gallons of water, and rinse well. Then dip the cotton in the dye as directed for wool.

Lily-of-the-Valley Leaves (*Convallaria majalis*)

On wool mordanted with chrome, the fresh, young leaves of lily-of-the-valley give a yellow green color. The fastness to light is fair, and to washing good. Leaves gathered in the late summer or fall give a gold color to wool mordanted with chrome. They do not dye cotton.

Yellow green.- For each pound of wool mordanted with chrome, use:

1-1/2 pecks shredded fresh, young lily-of-the-valley leaves

Mordant the wool yarn or cloth with chrome according to directions on page 6. Soak the leaves in water overnight. In the morning heat slowly and boil for 1 hour, strain, and add enough water for the dyebath. When cool, immerse the mordanted material, thoroughly rinsed and squeezed out of water, and boil for 45 minutes. Rinse and dry.

Mountain-Laurel Leaves (*Kalmia latifolia*)

On wool, mountain-laurel leaves produce a yellow tan with chrome mordant. The fastness to light is fair, and to washing good. Mountain-laurel leaves do not dye cotton. These shrubs grow in the eastern part of the United States.

Yellow tan.- For each pound of wool mordanted with chrome, use:

1-1/2 pecks shredded fresh mountain-laurel leaves

Mordant the wool with chrome according to directions on page 6. Soak the shredded leaves in water overnight. In the morning boil for 20 minutes, strain the dye liquor, and add enough water for the dyebath. When cool, immerse the mordanted yarn or cloth, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Rinse and dry.

Privet Leaves (*Ligustrum* sp.)

The dye from privet leaves produces a gold color on wool mordanted with chrome. This has good fastness to light and to washing. Cotton is not dyed. Privet is commonly used for an ornamental shrub or hedge.

Gold.- For each pound of wool mordanted with chrome, use:

1-1/2 pecks shredded fresh privet leaves

Mordant the yarn or cloth with chrome according to directions on page 6. Soak the shredded leaves in water overnight. In the morning heat gradually, boil for 20 to 25 minutes, strain out the leaves, and add enough water for the dyebath. When cool, immerse the wool, thoroughly rinsed and squeezed out of water, and boil for 20 to 30 minutes. Rinse and dry.

Tulip Tree Leaves (*Liriodendron tulipifera*)

Leaves of the tulip tree or yellow poplar produce on wool a gold color which has fair fastness to light and good fastness to washing. On cotton, this dye is not satisfactory. These trees are found in the eastern half of the United States.

Gold.- For each pound of wool mordanted with chrome, use:

1-1/2 pecks shredded fresh tulip tree leaves

Mordant the yarn or cloth with chrome according to directions on page 6. Soak the shredded leaves in water overnight. In the morning heat gradually, boil for 20 to 25 minutes, strain out the leaves, and add enough water for the dyebath. When cool, immerse the wool, thoroughly rinsed and squeezed out of water, and boil for 20 to 30 minutes. Rinse and dry.

Nut Hulls

The fresh green hulls or outer coverings of many nuts contain tannin and coloring materials which can be used for dyeing purposes. They produce shades of brown and gray that are fast to light and to washing. The dyes obtained from the hulls of pecan, of a pecan x shellbark hybrid, and of black walnut are discussed here. In addition to these nut hulls, those of the butternut produce very satisfactory colors on wool and cotton. The same directions as for dyeing with black walnut hulls may be followed.

Pecan Hulls (*Hicoria pecan*)

On wool, pecan hulls produce a brown which has fair fastness to light and washing. On cotton, they give a dark gray with fair color fastness. Pecan trees grow in Iowa, Indiana, and the southern states.

Brown.- For each pound of wool mordanted with alum, allow:

3/4 peck green pecan hulls

Mordant the wool with alum according to directions on page 6. Cut the hulls from the nuts and boil in water for 15 minutes. Strain, add enough water for the dyebath, immerse the material, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Rinse and dry.

Gray.- For each pound of cotton mordanted with alum, allow:

3/4 peck green pecan hulls

1/6 ounce ferrous sulfate (copperas)

Mordant the material with alum according to directions on page 7, and dye as for "Brown." Without rinsing, put the yarn or cloth in a boiling bath of the ferrous sulfate, stir carefully, and boil 5 minutes. Rinse and dry.

Pecan x Shellbark Hybrid Hulls (Burlington variety)

On wool, pecan x shellbark hulls give a rose tan with fair color fastness.

Rose tan.- For each pound of wool mordanted with alum, allow;

3/4 peck green pecan x shellbark hulls

Mordant the wool with alum according to directions on page 6. Cut the hulls from the nuts, and boil in water 15 minutes. Strain, add enough water for the dyebath, immerse the yarn or cloth, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Rinse and dry.

Black Walnut Hulls (*Juglans nigra*)

Both the hulls and shells of the black walnut are used for dyes. The hulls must be collected green. They then may be dried. Many people believe that the dye prepared from dried hulls is better than from fresh ones. Another method often used is to store the green hulls away from the light, keeping them well covered with water. The color becomes darker brown and seems to improve on standing.

On unmordanted wool, black walnut hulls give a dark brown which has good color fastness. With alum the color is somewhat brighter and its fastness to light is fair. With a tin mordant it gives dark reddish brown with fair color fastness. Avoid long boiling of wool in the walnut hull dyebath for it makes the wool harsh. On cotton, the hulls produce a drab which has good fastness to light and fair fastness to washing. By another dye method a darker color is obtained. The color fastness is fair.

Dark brown.- For each pound of unmordanted wool, allow:

3/4 peck green hulls from black walnuts

Soak the hulls for 30 minutes, boil 15 minutes, strain, and add enough water for the dyebath. Immerse the yarn or cloth, thoroughly wet and squeezed out of water, and boil for 20 minutes. Rinse and dry.

Reddish brown.- Mordant the wool yarn or cloth with tin according to directions on page 6 and dye as directed under "Dark brown."

Drab.- For each pound of cotton mordanted with alum, allow:

3/4 peck green hulls from black walnuts

Mordant the material with alum according to directions on page 7, and dye as directed for "Dark brown." A darker drab is obtained if the dyed material is put, without rinsing, into a boiling bath containing 1/6 to 1/2 ounce ferrous sulfate (copperas). Boil 5 or 10 minutes longer; rinse and dry.

Roots

Roots of some plants and trees contain coloring materials. For instance, madder, the ground root of a plant, gives lovely fast colors. The dry outer skins of onions make a good golden brown on wool. The root of the common barberry, sassafras, and turmeric, and the garden beet also contain coloring materials. However, their color fastness is poor, and they are not discussed here.

Madder (*Rubia tinctorum*)

Madder dye is made by grinding the root of the madder plant, which has been cultivated for a dyestuff for centuries. The ancient Egyptians used it, the Moors cultivated it in Spain, and during the 16th century it was brought to Holland. Madder was also extensively grown in France and Turkey, but most of it today is imported from Holland. It can be obtained from dye supply houses.

Because of the beauty and fastness of its tints and the range in colors produced by variation in the mordant, madder was once considered the most important of all dyestuffs. However, now it has little commercial value for it has been replaced by the coal tar product alizarine. This coloring principle is identical in composition and properties to that in madder. Purpurin, another coloring material in madder, produces a color similar to alizarine.

On wool, madder gives lacquer red and henna colors which are very fast to light and to washing. When combined with quercitron, it produces a bright orange. The light fastness is fair and washing fastness good. On cotton, madder gives the well-known Turkey red, but the process of dyeing is rather complicated and requires much time for completion.

Lacquer red.- For each pound of wool mordanted with alum, allow
8 ounces madder

Mordant the wool in alum according to the directions on page 6. Soak the madder in a small quantity of water overnight, bring to boiling, and pour into the dyebath. Immerse the yarn or cloth, thoroughly rinsed and squeezed out of water, heat slowly, and boil for 45 minutes. Rinse and dry.

A dark lacquer red is obtained by using twice as much madder. Mordant the wool in alum and soak the madder overnight as before. In the morning add enough water for the dyebath, immerse the material, thoroughly rinsed and squeezed out of water, and heat gradually. Do not boil but keep at 140° to 158° F., stirring constantly for 2 hours. Let cool in the bath, rinse, and dry.

Henna.- For each pound of wool mordanted with alum, allow
8 ounces madder
4/5 ounce oak galls
1/3 ounce ferrous sulfate (copperas)

Mordant the wool in alum (see page 6.) Soak the madder in water overnight. In the morning add water for the dyebath, immerse the yarn or cloth, thoroughly rinsed and squeezed out of water, heat slowly, stir constantly, and boil 30 minutes. Remove material from dyebath, add oak galls, return, and boil 30 minutes longer. Again remove the wool, add the ferrous sulfate, return, and boil for a few minutes. Let the material cool in the dyebath, rinse, and dry.

Bright orange.- For each pound of wool, allow:

1/2 ounce cream of tartar

1 ounce stannous chloride

1/2 ounce quercitron extract

1-1/2 ounces madder

Dissolve the cream of tartar and three-fourths of the stannous chloride in water, immerse the yarn or cloth, thoroughly wet and squeezed out of water and boil for 45 minutes. Remove the material, add the quercitron, madder, and remainder of stannous chloride, and stir well until dissolved. Return the wool to the bath, stir carefully, and boil for 30 minutes. Rinse and dry.

Onion Skins (*Allium cepa*)

The dry outer skins of the bulb of the onion have long been used for coloring fabrics. They contain the coloring principle quercetin and probably a tannin associated with it. Depending on the mordant used, the dry outer skins of the yellow globe onion give on wool a dull orange and a brass color. The color fastness of the dull orange is fair, and the brass color is fair to light and good to washing. On cotton, the color fastness is poor.

Dull orange.- For each pound of wool mordanted with alum, allow:

10 ounces dry yellow globe onion skins

Mordant the yarn or cloth with alum as directed on page 6. Boil the onion skins in water for 15 minutes, strain, and add enough water for the dye-bath. Immerse the material, thoroughly rinsed and squeezed out of water, stir carefully, and boil for 30 minutes. Rinse and dry.

Brass.- For each pound of wool mordanted with chrome, allow:

10 ounces dry yellow globe onion skins

Mordant the yarn or cloth with chrome (see page 6) and proceed as for "Dull orange."

Woods

Coloring matter suitable for dyeing yarns and fabrics can be obtained from the wood of certain trees. The following dyes extracted from woods give fast colors on wool. Mulberry wood also gives a dye but its colors are not fast.

Cutch (*Areca* and *Acacia* spp.)

Cutch or catechu, one of the most important brown vegetable dyes, is the dried extract obtained from certain plants and trees growing in India, Java, and the East Indies. Bombay cutch which is considered the best is prepared from the fruit and wood of the *Areca* catechu, a kind of palm. Cutch contains two principal coloring matters, catechin and catechu-tannic acid. It can be obtained from houses supplying dyes and botanical drugs.

On both cotton and wool, cutch gives a fine rich brown when applied with copper sulfate and potassium dichromate. On cotton, its fastness to light is fair, and fastness to washing, good; on wool, both are good.

Brown.- For each pound of wool or cotton, allow:

- 1/5 pound cutch
- 2/5 ounce copper sulfate
- 2/5 ounce potassium dichromate

Boil the cutch and copper sulfate in water until well dissolved. While still hot, put in the yarn or cloth which has been boiling a short time in clear water, stir well, and let stand overnight. In the morning, squeeze the material from the cutch solution and put into a hot bath made by dissolving the potassium dichromate in water. Stir well and let stand in this for 45 minutes just below boiling temperature. Rinse and dry.

Fustic (*Chlorophora tinctoria*)

Fustic is probably one of the best yellow dyes found in nature. It is obtained from the wood of a tree that grows in Mexico, Cuba, and Nicaragua. It can be purchased either in the form of a chipped wood or as an extract. The coloring principles contained in fustic are morin and morin-tannic acid, often called maclurin.

On wool mordanted with chrome, fustic produces a gold color with good fastness to light and good fastness to washing. The colors with alum and tin mordants are brighter but they are not fast to light. On cotton, fustic does not give a fast color.

Gold.- For each pound of wool mordanted with chrome, use:

- 1/2 ounce fustic extract

Mordant the wool with chrome according to directions on page 6. Dissolve the fustic in enough water for the dyebath, immerse the yarn or cloth, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Rinse and dry. Prolonged boiling should be avoided as this causes the color to become dull and brown.

Logwood (*Haematoxylon campechianum*)

Logwood is still one of the most extensively used natural dyestuffs. It is obtained from a tree which grows principally in Cuba, Jamaica, and Central America. It can be purchased as chipped wood or as an extract either in liquid or solid form, and can be obtained from dye and botanical drug supply houses.

The coloring principle of logwood is hematoxylin and this on oxidation yields hematine, the real coloring matter of prepared logwood. In combination with various mordants it gives a wide range of colors: dark blue with chrome, purple with alum, and black with iron. Their fastness to light varies considerably, but most of them fade rather rapidly. In fact, because of the fugitive character of this dye, Queen Elizabeth issued an edict prohibiting its use and directing that all logwood found should be burned.

On wool, the black produced with iron and sumac is fast to light and fast to washing. On cotton, the colors are not fast.

Black.- For each pound of wool, allow:

- 9 ounces logwood chips
- 1/2 ounce fustic extract
- 1-1/2 pecks chopped sumac leaves and twigs
- 1 ounce sodium carbonate (washing soda)
- 1/4 ounce ferrous sulfate (copperas)
- 3/5 ounce potassium dichromate

Soak the fresh sumac leaves and twigs in water overnight. In the morning boil for 30 minutes, strain, and add enough water for the mordant bath. Enter the yarn or cloth, thoroughly wet and squeezed out of water, and soak overnight. The next morning, squeeze out the material and without rinsing work for 10 minutes in a bath of the sodium carbonate at 122° to 140° F. Then squeeze out the wool and work in a cold solution of ferrous sulfate for 30 minutes. Return to the soda bath for 15 minutes and rinse thoroughly. Tie the logwood chips in a cheesecloth bag, boil for 20 minutes, and add the logwood extract and chips together with the fustic, to enough water for the dyebath. Enter the yarn or cloth and boil for 30 minutes, then pass through a warm solution of the potassium dichromate. Rinse well, work in warm soap suds, rinse, and dry.

Osage Orange Wood (*Toxylon pomiferum*)

Osage orange is obtained from the wood of the osage orange tree found in great abundance in the southwestern districts of the United States. It can be purchased both as the liquid extract and as the solid or powdered form. The chipped wood can also be used and the dye extract prepared as for logwood. The Indians dyed with osage orange wood for many years. Its coloring principles, morin and maclurin, are identical with those found in fustic.

Depending on the mordant used, osage orange produces on wool a yellow tan with good color fastness and a gold color which has fair fastness to light and good fastness to washing. On cotton, its colors are not fast.

Yellow tan.- For each pound of wool mordanted in alum, allow

- 1/2 ounce osage orange extract
- 1/6 ounce potassium dichromate
- 1/6 ounce acetic acid, or 6 to 7 tablespoons vinegar

Mordant the wool with alum according to the directions on page 6. Dissolve the osage orange extract in enough water for the dyebath, immerse the material, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Without rinsing, put the yarn or cloth in a boiling bath of the potassium dichromate and acetic acid. Stir carefully and boil for 15 minutes. Rinse and dry.

Gold.- For each pound of wool mordanted with chrome, use:

- 1/2 ounce osage orange extract

Mordant the wool with chrome according to the directions on page 6. Dissolve the osage orange extract in enough water for the dyebath, immerse the yarn or cloth, thoroughly rinsed and squeezed out of water, and boil for 30 minutes. Rinse and dry.

Cochineal and Mineral Dyes

Cochineal (Coccus cacti)

Cochineal is prepared from a dried insect found in Mexico and Central America. It can be obtained from many drug and dye supply houses. The coloring principle of this dye is carminic acid.

On wool, cochineal produces colors that have good fastness to light. Most of them are fast to washing, but some become slightly bluer though they do not run or bleed. The colors American beauty red and purple have good fastness to washing as well as good fastness to light. Cochineal is not a satisfactory dye for cotton.

Rose pink.- For each pound of wool, allow:

- 2 ounces powdered cochineal
- 4 ounces oxalic acid
- 4 ounces stannous chloride
- 1 ounce cream of tartar

Tie the cochineal in a cheesecloth bag and soak overnight in a little water. In the morning, add the oxalic acid, stannous chloride, and cream of tartar, and boil for 10 minutes. Then add enough water for the dyebath, immerse the wool, thoroughly wet and squeezed out of water, and bring slowly to the boil (about $3/4$ hour). Boil for 1 hour, rinse, and dry.

Flag red.- For each pound of wool, allow:

- $3-1/3$ ounces powdered cochineal
- $3-1/3$ ounces cream of tartar
- $1-3/5$ ounces concentrated nitric acid
- $1/4$ ounce stannous chloride

Soak the cochineal and cream of tartar in water, and add to the boiling water for the dyebath. Boil for 10 minutes, then strain, and add the nitric acid and stannous chloride previously dissolved in 1 cup of water. (Caution:- Always pour acid into water; never water into acid.) Put in the dry wool, stir well, and let boil for 1-1/2 hours. Stir constantly. Rinse and dry.

American beauty red.- For each pound of wool mordanted with alum, allow:

- 1 ounce powdered cochineal

Mordant the wool with alum according to directions on page 6. Soak the cochineal in water for 1 hour, boil for 15 minutes, and add enough water for the dyebath. Immerse the wool, thoroughly rinsed and squeezed out of water, heat gradually, and boil for 2 hours. Rinse and dry.

Purple.- For each pound of wool mordanted with chrome, allow:

- $2-1/2$ ounces powdered cochineal
- 1 teaspoon vinegar

Mordant the wool with chrome according to directions on page 6. Boil the cochineal and vinegar in a little water for 10 minutes. Add enough water for the dyebath, immerse the mordanted wool, thoroughly rinsed and squeezed out of water, boil for 2 hours, rinse, and dry.

Chrome Yellow

On cotton, lead acetate and potassium dichromate produce a bright yellow without a mordant. The color fastness is good; on wool it is poor.

Yellow.- For each pound of unmordanted cotton yarn or cloth, allow:

3 ounces lead acetate
1 ounce potassium dichromate

Dissolve the lead acetate and potassium dichromate separately. Dip the cotton, thoroughly wet and wrung out of water, in lead acetate and then in the potassium dichromate. Stir well, repeat four times; rinse, and dry.

Iron Buff

On cotton, without a mordant, ferrous sulfate produces a buff color which has fair fastness to light and washing. On wool, the fastness to light is poor.

Buff.- For each pound of unmordanted cotton yarn or cloth, use:

6 ounces ferrous sulfate (copperas)
6 ounces powdered soap

Dissolve the ferrous sulfate in water, put in the cotton, thoroughly wet and squeezed out of water, stir for a few minutes, remove, and drain. Then dip it into soap suds, stir, and wring. Repeat three times; then rinse and dry.

Manganese Brown

On wool, potassium permanganate produces a dark brown without a mordant. The color fastness is good. On cotton, the color is not fast.

Dark brown.- For each pound of unmordanted wool yarn or cloth, use:

4 ounces potassium permanganate

Dissolve the potassium permanganate in water, immerse the material, thoroughly wet and squeezed out of water, and stir well so that all is covered. Remove and air until the color becomes brown, and re-dip. Repeat the process until dark enough, then dry. Wash in warm suds, rinse, and dry.

Prussian Blue

On cotton, ferrous sulfate and potassium ferricyanide produce a sky blue without a mordant. The color fastness is good. The color is poor on wool.

Sky blue.- For each pound of unmordanted cotton yarn or cloth, allow:

1/2 ounce ferrous sulfate (copperas)
1/4 ounce potassium ferricyanide
1/4 ounce concentrated sulfuric acid

Dissolve the ferrous sulfate, immerse the cotton, thoroughly wet and wrung out of water, heat slowly and keep just below boiling for 1 hour, then rinse. Pour the sulfuric acid into fresh water and add the potassium ferricyanide. (Caution: - Always pour acid into water; never water into acid.) Put in the cotton, stir often, and let stand 1 hour; rinse, and dry.

TABLE OF COLORS

<u>Color</u>	<u>Dye Material</u>	<u>Fiber</u>	<u>Page</u>
<u>Black</u>			
Black -----	Logwood chips -----	wool -----	22
<u>Blue</u>			
Sky blue -----	Prussian blue -----	cotton -----	24
Dark blue -----	Indigo -----	wool and cotton	15
<u>Brown</u>			
Yellow tan -----	Apple bark -----	wool -----	10
	Birch bark -----	wool -----	10
	Mountain-laurel leaves -----	wool -----	16
	Oak bark, Black (Quercitron) -----	wool -----	12
	Oak bark, Chestnut -----	wool -----	12
	Oak bark, Northern red -----	wool -----	12
	Osage orange wood -----	wool -----	22
	Tupelo bark -----	wool -----	13
Dark yellow tan -----	Apple bark -----	wool -----	10
	Tupelo bark -----	wool -----	13
	Walnut bark, Black -----	wool -----	13
Rose tan -----	Maple bark, Norway -----	wool -----	10
	Oak bark, Northern red -----	wool -----	12
	Pecan x shellbark hulls -----	wool -----	18
	Willow bark, Black -----	wool -----	13
Greenish tan -----	Maple bark -----	wool -----	11
	Oak bark, Northern red -----	wool -----	12
	Tupelo bark -----	wool -----	13
Light brown -----	Gum bark, sweet -----	wool -----	10
	Maple bark, Norway -----	wool -----	10
	Oak bark, Northern red -----	wool -----	12
	Willow bark, Black -----	wool -----	13
Yellow brown -----	Birch bark -----	wool -----	10
	Oak bark, White -----	wool -----	12
	Walnut bark, Black -----	wool -----	13
Dark yellow brown ---	Hickory bark -----	wool -----	10
	Walnut bark, Black -----	wool -----	13
Brown -----	Cutch -----	wool and cotton	21
	Oak bark, Chestnut -----	wool -----	12
	Pecan hulls -----	wool -----	17
Reddish brown -----	Walnut hulls, Black -----	wool -----	18

<u>Color</u>	<u>Dye Material</u>	<u>Fiber</u>	<u>Page</u>
<u>Brown (Continued)</u>			
Dark brown -----	Manganese brown -----	wool -----	24
	Walnut bark, Black -----	wool -----	13
	Walnut hulls, Black -----	wool -----	18
Drab -----	Maple bark -----	wool -----	11
	Walnut hulls, Black -----	cotton -----	18
Khaki -----	Juniper berries -----	wool -----	14
	Maple bark -----	wool -----	11
<u>Gray</u>			
Gray -----	Pecan hulls -----	cotton -----	18
<u>Green</u>			
Yellow green -----	Lily-of-the-valley leaves ---	wool -----	16
<u>Orange</u>			
Buff -----	Iron buff -----	cotton -----	24
Bright orange -----	Madder -----	wool -----	20
Dull orange -----	Onion skins -----	wool -----	20
Terra cotta -----	Coreopsis flowers -----	wool -----	14
<u>Purple</u>			
Purple -----	Cochineal -----	wool -----	23
<u>Red</u>			
Rose pink -----	Cochineal -----	wool -----	23
Flag red -----	Cochineal -----	wool -----	23
Lacquer red -----	Madder -----	wool -----	19
Henna -----	Madder -----	wool -----	19
American beauty -----	Cochineal -----	wool -----	23
<u>Yellow</u>			
Yellow -----	Chrome yellow -----	cotton -----	24
Gold -----	Fustic -----	wool -----	21
	Oak bark, Black (Quercitron) -	wool and cotton	11
	Osage orange wood -----	wool -----	22
	Privet leaves -----	wool -----	17
	Tulip tree leaves -----	wool -----	17
Brass -----	Apple bark -----	wool -----	10
	Marigold flowers -----	wool -----	14
	Onion skins -----	wool -----	20

